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most important being: (1) That the hospital shall admit to the wards students of the medical schools to the extent and in the manner permitted by the most approved practise. (2) That the educational institution concerned may make nominations to all positions on the hospital staff, medical, surgical and special.

THE completion of the fund of \$750,000 for the Johns Hopkins University is announced. This insures the payment to the fund of a further \$250,000 offered conditionally in February of last year by the General Education Board.

By the will of Mrs. Martin Kellogg, Yale University receives a bequest of \$50,000 from the estate of the late Martin Kellogg, who was formerly president of the University of California.

MR. H. J. PRIESTLEY, M.A., assistant lecturer in mathematics at the University of Manchester, has been appointed professor of mathematics and physics in the newly-constituted University of Queensland.

DISCUSSION AND CORRESPONDENCE

SYMBOLS IN ZOOLOGICAL NOMENCLATURE

PROFESSOR NEEDHAM'S proposal¹ of a plan for practical nomenclature deserves more attention than has yet been given it publicly. To be sure, our energetic friend Professor Cockerell has published a brief destructive critique² based on personal opinion as to what can be most easily retained by the memory, and on sentiment. As to the former, one might differ from him in individual cases, or might justly observe that memory is not the only factor involved in Professor Needham's proposal. So far as sentiment goes the incongruity and falsity of many names will make as good an argument on the other side of the question, while the colorless number adapts itself far better to changing interpretations with the progress of science than any word with its fixed relation to ideas. Nor can I believe that it is any part of scientific

nomenclature to "call up pleasanter [philological] thoughts." It certainly is worth while to have the great names of the past brought to our attention, but such men are in our thoughts constantly not because they have named a few species more or less, but because they have made real contributions to the progress of science. And what shall one say of the constant burdensome recurrence in systematic work of the names of the unknown, of those who have torn down the good work of their associates and have left the roadway of science rocky with synonyms, errors in determination and description, false statements and careless records, misspellings and misquotations. It is these rocks in the way that make the pilgrim to-day toil wearily up the height more conscious of the obstacles such men have left than of the substantial roadway the real workers have constructed.

But to my mind all of this fails to reach the heart of the problem or in any way to affect the fundamental contentions urged by Professor Needham. For this reason I am anxious to aid if possible in directing attention to the real questions at issue and the probable lines for their successful solution.

The history of all science shows intercurrent tendencies towards simplification and complication. The data already established are reduced to greater simplicity in expression and the new relations that are demonstrated involve them at the same time in constantly increasing complexity. That simplification in terminology is a real tendency is apparent to every one who studies the history of zoology and compares the long and involved circumlocutions of early writers with the more precise designations of to-day. Hand in hand with this simplification in form goes a movement towards standardization in use and meaning which finds its expression in modern terminology. The term becomes more precise as it becomes more limited and because its use is limited.

The history of zoology does not in this respect differ from the past of other sciences and yet the comparison shows that some other sciences have progressed further along this

¹ SCIENCE, September 2, 1910, pp. 295-300.

² SCIENCE, September 30, 1910, p. 428.

line of development than zoology has yet gone. Such a simplification by the employment of symbols has become thoroughly incorporated into the substance of some sciences and is proposed for introduction into others. An examination of these conditions shows some interesting and in my opinion valuable considerations for this discussion.

Probably because numbers were the basis of mathematics the origin of the science is often said to date from the invention of numbers. But even with that it may be noted that the symbols were not in all cases identical and in one system Roman letters were employed, whereas another used Arabic numerals for the same general purpose. Nor can one well doubt the superiority of the Arabic notation over the Roman even if sentimental grounds lead one to prefer the classical to the Moorish civilization in laws, government or other social conditions. Probably mathematics represents the most highly developed of all sciences and the modern mathematician is not deterred from the use of symbols by any danger of misprinting, confusion, error of memory or other similar objection, real though each of them is in this case also.

The case of chemistry is even more enlightening because the introduction and universal use of symbols is of comparatively recent date. One does not have to seek far to find arguments against the use of symbols for the designation of chemical elements which read strikingly like the objections of Professor Cockerell to the plan which Professor Needham advocates. Errors do occur in chemical literature, proofreading is far more difficult because of the numerous easily confused symbols in use to-day and the abandonment of those quaint old names which disclose some of the secrets of the alchemist and of the mystic age of chemistry, was a real sentimental loss. Yet I doubt if any one could now be found who would seriously contend that we should return to the presymbolic days even if it were possible to express modern chemical work in ancient form. Simplification through the use of symbols has come to stay in chemistry as in mathematics.

It is no argument whatever against the general proposal to introduce some such system into biological sciences to say that the latter are less precise, that their units are more numerous and more complicated than those of mathematics or chemistry. If the problem had been as simple it would have been solved as easily as were the others. The delay in reaching any solution indicates the existence of difficulties but does not afford any basis for rejecting efforts to solve the problem or for characterizing the problem as insoluble along this line. The greater complications of biology make its development slower because they demand for their consideration and analysis a more highly organized general scientific foundation and a more highly trained body of scientific workers. The solution may not come in our time, but it will surely come some day.

But other sciences also are looking for possibilities of simplifying and of standardizing their forms of expression in the manner so successfully adopted by chemistry. One example of most recent date may suffice to show the tendency. This is taken from what may be regarded as the most recent addition to the circle of sciences, geography. In an address before the Geographical Section of the British Association at Sheffield this year, the brilliant young Oxford geographer, A. J. Herbertson,^a dwells upon this matter, saying in introduction, "I have long thought that we shall be driven to some notation analogous to that of the chemists." After suggesting a possible scheme for consideration he adds: "This is the roughest suggestion, but it shows how we could. . . . No doubt there would be many discussions. . . . But after all these discussions would be more profitable than quarrels as to which descriptive term, or place name or local usage should be adopted to distinguish it."

With only minor changes in phraseology this description of dangers and profitless discussions which geography should avoid portrays actual conditions in the zoological field.

^a SCIENCE, November 25, 1910, p. 745.

Zoological nomenclature has received heroic treatment during the past ten or fifteen years. The difficulties which had arisen in the natural course of development under the Linnæan system had led to numerous isolated efforts for their correction until finally an attempt has been made to remedy the evils under the control of a central organization which has been so firmly established by zoologists as to be at present beyond their control and swayed by laws alone. Yet even such an autocratic and omnipotent body has not succeeded in doing more than increasing the difficulties of the situation. It really seems as if the problem requires more radical measures for its solution. The present plan of organization is incapable of coping with the complications which have arisen in the rapid expansion of biological knowledge during the last half century. Personally, I am convinced that the Linnæan system offers no probability of meeting the situation. Of this there may be some question, but there is abundant evidence to show that the existing zoological nomenclature is meeting with wide-spread criticism and does not command the support to be expected of so fundamental a system. Indirect but weighty evidence of this may be found in the fact that the use of common names is increasing and that a larger proportion of biological workers than ever before are avowedly indifferent to the use of technically correct scientific names.

Present conditions are denominated unsatisfactory by able men in many places and in diverse special lines of work in the general field. The most important general criticisms of the existing conditions may be stated briefly as follows:

1. *Lack of Stability.*—Present nomenclature by law depends upon the accuracy of the past and upon the completeness of our knowledge concerning its work. At any time demonstration of an error in statement or of an omission in the references to previous work may overturn a name or series of names and throw all the literature on the group into confusion. New laws and new rulings are made with the same result, for in our effort

to out-Herod Herod we go further than the law, that most conservative of professions, has ever gone. We make and enforce *ex post facto* laws which upset the established practise of a century.

2. *Overemphasis upon Trivial Features.*—Page-long discussions recur constantly on the acceptance of *A*'s name or *B*'s name and both sides argue with apparent justice and at interminable length. Articles follow hard on each other's heels dealing exclusively with the spelling of names: Shall it be *somum* or *soma*? Shall one write *nui* or *nii*? And the questions are never decided, for even the high priests of the movement differ in their views and their practises, and the great majority of biological workers pay little attention to the strife because they feel the issues are trivial. Now the real meat of the question is the thing and not its name. And all this energy devoted to a study of the animal itself would yield much of value to science. The workman does not care whether *A* or *B* gives him his tools; he wants a tool and wants it sharp, because he wants to do work with it. He is rightly impatient of so much hair splitting to so little purpose, but he does look forward to the time when in some way this energy may be diverted into productive channels.

3. *Exaltation of Error.*—If a tyro commits an error, if a neophyte goes astray or makes a foolish move, we are accustomed in science otherwise to consign his work to kindly oblivion, but in nomenclature this may not be. The skeleton of his misbirth must be hung in the public hall of the systematic museum, to dangle its misshapen bones before both students and visitors for all time. There is no other option possible to-day under the laws of nomenclature. A mistake once incorporated in the literature of biology must forever remain there, even though apparent to the man of education at a glance. The most conservative theologian would hesitate to support such an inflexible demand for the maintenance of the past, errors and all. And the very fact that able and zealous advocates of present nomenclature contend there is no other way under the present system compels

the conclusion that this system is insufficient for the needs of a science which seeks to eliminate error and to establish truth.

4. *Multiplication of Complications.*—No one can doubt that the complexity of zoological nomenclature has increased enormously within very recent years. Furthermore, no one will deny that much of this increase is due to the expansion in our knowledge of the biological world and its interrelations. This natural growth in complexity is as welcome as it is inevitable, but if real progress is to be achieved it must be accompanied by a perfection and simplification of the machinery of control and of investigation in which a prominent element is the systematic nomenclature of the subject. Now there is reason to believe that the system in use has become unnecessarily intricate, that its parts are involved by the nature of the case in ways such as to create grave difficulties for the ordinary worker. These difficulties are certainly greater to-day than they were twenty years ago and this result has been produced by the changes and complications incident to the new legislation in the subject during very recent years. Such changes may have been wise and necessary from the legal standpoint, they may be perfectly in line with the natural development of the present system. But that only strengthens my contention that zoology must look for a better system, must seek a way of escape along an entirely new line. I am aware also that these changes meet the approval of those who have devoted much time to the study of taxonomy and that they do not regard the complications as hindrances to progress. No doubt from their point of view this is true, but there is another aspect of the question which deserves careful examination.

To the skilled systematist, thoroughly acquainted with his own groups, confident, accurate, critical, these difficulties constitute intellectual stimuli rather than stumbling blocks. He follows the changes in names with delight in the history of the science that they portray. Outside his own corner of the field he often does not care to go, or if he wanders

it is not so far afield that he is at a loss to find the necessary help to keep him in the path. But to the general worker this constant shifting constitutes a real burden that retards his progress and reduces the efficiency of his work. This is, however, not the most serious feature of the case.

To the general public even in the educated world scientific names will perhaps remain as they unfortunately now are regarded, "beyond the powers of ordinary mortals," and birds and beasts, insects and shells, will continue to be called by their popular names because the latter are not only simpler, but also do not change from day to day. But to the neophyte who hesitates on the threshold of the science, uncertain whether he shall enter or who later pauses before he essays to mount to higher levels in the fields of our elysium, the difficulties which our present nomenclature sets in his path are at best disheartening. He would read of the great work of the past and know its relation with that of the present. But you must tell him that *Amphioxus* is not such but *Branchiostoma*, that *Holothuria* is not an echinoderm, that even *Amæba* to-day is *Chaos*!—and a multitude more changes which confuse his mind and dull his enthusiasm. He wants to study life, not letters. But at the very start of his work he is forced to violate that canon of accuracy which is the foundation of science or to assume a burden that wastes his energy in a vain effort to keep up with the latest revisions of nomenclature. Like Sindbad the Sailor, he struggles along with this Old Man of the Sea on his back until he decides to be quit of his burden, and without openly indicating his purpose, contrives to wander off with the morphologists or biologists, leaving nomenclature behind.

Now these multifarious complications are the necessary and logical consequences of the system of laws which zoologists themselves have adopted and as such are unavoidable in the opinion of the expert legalist. The natural reply to such a dictum is then let us follow the promptings of our scientific consciences and devise some better system. Why should we not find a simpler and effective

method of designation in a system of symbols such as other sciences have found? I am not in sympathy with those who look for relief in a laxer more open administration of the present system. Such a line of action does not seem to me likely to prove either effective or legitimate.

This rigor in systematic nomenclature is a natural reaction from the free and easy methods which have prevailed in the past. Biological science even to-day publishes loose, inaccurate statements in research contributions which would be laughed out of court in physics or chemistry, to say nothing of mathematics or astronomy. It is necessary that some reform be undertaken, that our branch of science approach more closely to the precision in observation and experiment, in record and discussion that characterizes older sciences. The natural lack of fixity in biological phenomena has been utilized to excuse a lack of precision in method and investigation which must be corrected. One effort to reach a more justifiable basis is seen in the recent development of statistical work, and in the publication of definite numerical results rather than merely generalizations in connection with experimental work, in the effort to control more accurately and state more precisely the conditions of such experimentation and to analyze more closely the results obtained. In such lines zoology has achieved wonderful progress in the last twenty years or even less.

The same influences will lead to a reform of our system and, following the lead of other sciences, such a reform is likely to be accompanied by the simplification which is associated with the utilization of symbols. The far-seeing biologist should be on the watch for a plan which promises some measure of success in this line, he should welcome all reasonable attempts at the solution of the problem. Of course he will not reject any and all systems because they are new departures; and yet he should not fail to subject each to careful consideration because it may seem to be inadequate or only partially worked out. Out of such careful discussion will come the longed-

for result in a workable form. But the system itself will represent contributions from many sources.

I confess that Professor Needham's plan seems to me at most only a partial solution of the problem. Even as such it may prove to be of great value and it is to be hoped that biological workers may be willing to try it on various groups in diverse portions of the field and may then report on their results. Better still if it could be subjected to a trial by some recognized society or institution with a view to testing thoroughly its character. It would be valuable to compare it carefully with the much more complex system proposed some years ago by Tornier⁴ which seems to have attracted no attention, although it was a most ingenious and original means of formulating a symbolism for zoological nomenclature. While this system was much more complex and covered not only species as proposed by Professor Needham's plan, but also genera, and indicated the precise place in class, order and family occupied by each genus and species, yet apparently the symbol used for a given form would not be permanent and independent of changing views regarding the position and relationship of genera and higher groups. This lack of stability would be a serious, if not fatal, objection to the introduction of a new system planned to correct precisely the same defect in the old.

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BOTANICAL EVIDENCE OF COASTAL SUBSIDENCE

In a recent article¹ Professor D. W. Johnson calls attention to certain conditions at Scituate, Mass., which are there responsible for a fictitious appearance of coastal subsidence. During the "Portland Storm" of 1898 the bar was broken which at that locality almost separates the North River marshes and bay from the ocean, with the result that the high tide level on the marshes is now from one to several feet higher than it was then.

⁴ *Zool. Anz.*, Vol. 21, p. 575, October 24, 1898.

¹ *SCIENCE*, N. S., XXXII., 1910, p. 721.